DUSTFALL AND SNOW SAMPLING SURVEY

IN THE VICINITY OF

JAMES RIVER-MARATHON, LTD.

MARATHON, 1988

JUNE 1989

Environment Ontario

Jim Bradley
Minister

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INTRODUCTION

James River-Marathon, Ltd. operates a bleached kraft pulp mill approximately 400 metres west of a residential area in the Town of Marathon. Since 1984, wood supply for the mill has mainly been in the form of wood chips. The chips are stored in large piles about 100 metres north of a residential area. In response to complaints of windblown wood fibres from the chip piles, a snow sampling and dustfall survey was conducted in 1986. The results indicated that the fallout of wood fines near the chip piles caused a localized nuisance problem[1]. Subsequent action was taken by the company to reduce emissions from the chip piles. To document any changes in air quality resulting from this action, a second snow sampling survey was conducted in January, 1988. The most recent data from the company's dustfall monitoring network were also summarized for inclusion in this report.

METHODS

The locations of the James River-Marathon dustfall jars are shown in Figure 1. Open-top plastic containers were exposed for 30-day periods to collect fallout of particulate matter that settled out from the atmosphere by gravity.

Single samples of snow were collected on January 25, 1988 from 13 sites near the chip piles (Figure 2) and from two control sites remote from the study area. Sites 3, 11, 12 and 13 were added in the 1988 study to improve the distribution of sampling locations selected in 1986. Core samples of the complete snow profile were obtained following standard Ministry sampling procedures[2]. Snow meltwater was submitted to the Ministry's Thunder Bay and Toronto laboratories for determination of calcium, chloride, sodium,

sulphate, conductivity, pH, carbon (dissolved inorganic carbon, dissolved organic carbon, total particulate carbon) and solids (suspended solids, dissolved solids, total solids).

RESULTS AND DISCUSSION

Dustfall levels are reported in Table 1 for the 12-month period from September, 1987 to August, 1988. There were many exceedences of the monthly provincial air quality objective for dustfall at site 1 in the James River parking lot. Average dustfall in the residential area nearest the chip piles (sites 2 and 3) moderately exceeded the Ministry objective. About a third of average dustfall in this area was combustible matter, presumably mostly wood fines. At the residential monitoring site farthest from the chip piles (site 4), dustfall was low. At this location, the combustible fraction averaged only 15% of total dustfall.

Results from the 1988 snow sampling survey are presented in Table 2 along with data from 1986. Levels of chloride, sodium and sulphate were higher in 1988 than in 1986. Sodium and sulphate exceeded guidelines by a slight to moderate margin at most sites. The application of road salt may have caused the high sodium and chloride readings at site 4. Meltwater conductivity was generally higher in 1988 than in 1986; the guideline was exceeded at sites nearest the chip piles. Conductivity was also above the guideline at site 4, where several other parameters were elevated. The 1986 and 1988 pH levels were similar and were close to control values.

Except at site 4, concentrations of carbon and solids were highest near the wood chip piles and the kraft mill. While guidelines for these two parameters were moderately

exceeded at most sites, levels dropped from 1986 (except at site 7). Figures 3 and 4 illustrate similar distribution patterns for carbons and suspended solids in 1986 and 1988. These patterns suggest that the kraft mill complex, as well as the chip piles, may have been a source of particulate fallout. Microscopic examination of insoluble matter in snow meltwater from sites 4, 6, 7 and 10 revealed mostly wood fibres, plus sand and ash particles.

The deposition rates of total solids and particulate carbons were calculated. Based on data from the Terrace Bay weather station (approximately 55 km west of Marathon), snow was on the ground for 61 days prior to the 1988 snow sampling dates. The comparable period for the 1986 survey was 74 days. Deposition rates (Table 3) indicate that levels of carbon and solids have decreased since 1986 at most sampling points. The data suggests that dustfall may have exceeded the Ontario objective at some locations nearest the chip piles. Recent complaints (April and May, 1988) also suggest that wood fines as well as excessive noise continue to be a nuisance problem.

Correlation matrices for snow results are presented in Table 4. A number of parameters correlated strongly with each other, suggesting a common source; sodium, chloride and conductivity were closely correlated, as were solids and carbon. Solids and carbon showed strong negative relationships with distance from the kraft pulp mill and from the chip piles. These findings confirm the fallout patterns shown in figures 3 and 4.

DISCUSSION AND CONCLUSIONS

A dustfall and snow sampling survey was carried out in January, 1988 near the wood chip storage piles near the James

River-Marathon, Ltd. kraft pulp mill in the Town of Marathon. Dustfall in the residential area near the chip piles sometimes exceeded Ministry objectives, and combustible matter (including wood fines) in dustfall accounted for about a third of the fallout. Snow survey results suggest that the chip piles were a source of airborne wood fines. However, the kraft mill complex may also be a contributing source of particulate matter emissions. Concentrations and deposition rates of carbons and solids have generally decreased since 1986, but occasionally still exceed Ministry guidelines near the chip piles. Chloride, sodium and sulphate levels have increased since 1986 and exceeded guidelines at many locations.

The Ministry has found difficulty in quantifying wood fines emissions to document nuisance fallout complaints. Existing measurement methods and air quality objectives have some deficiencies in assessing this type of problem. The Ministry is conducting research on improvements in monitoring and controlling wood fines discharges from several sources in Ontario.

ACKNOWLEDGEMENT

We wish to thank James River-Marathon, Ltd. for providing dustfall data from their monitoring network.

REFERENCES

1. Racette, D. J. and H. D. Griffin, 1987. Dustfall and snow sampling survey in the vicinity of James River-Marathon, Ltd., Marathon, 1985-86. Ontario Ministry of the Environment.

2. Ontario Ministry of the Environment. 1983. Field Investigation Procedures Manual. Phytotoxicology Section, Air Resources Branch.

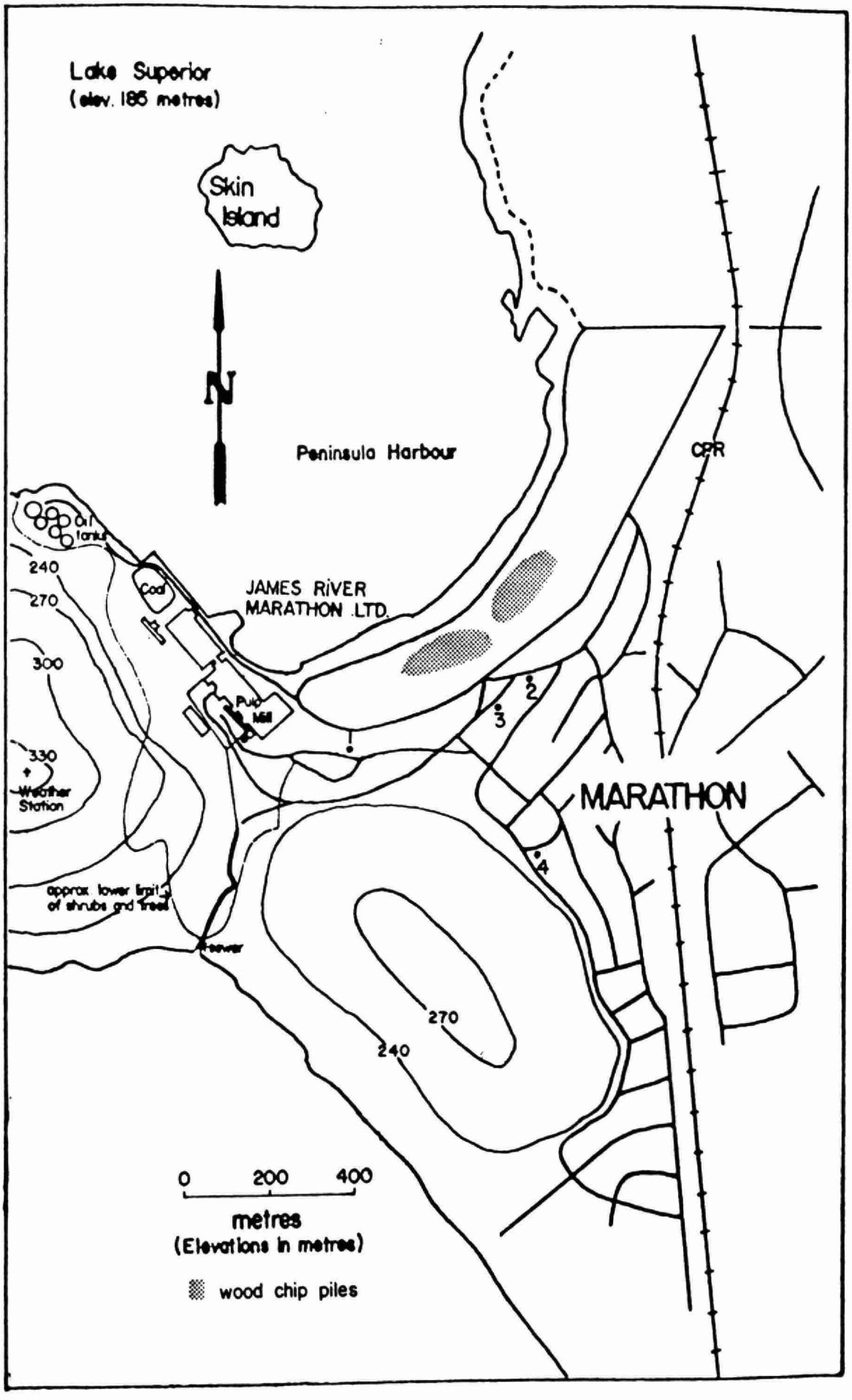

Figure 1. Dustfall monitoring sites, Marathon, September, 1987 to August, 1988.

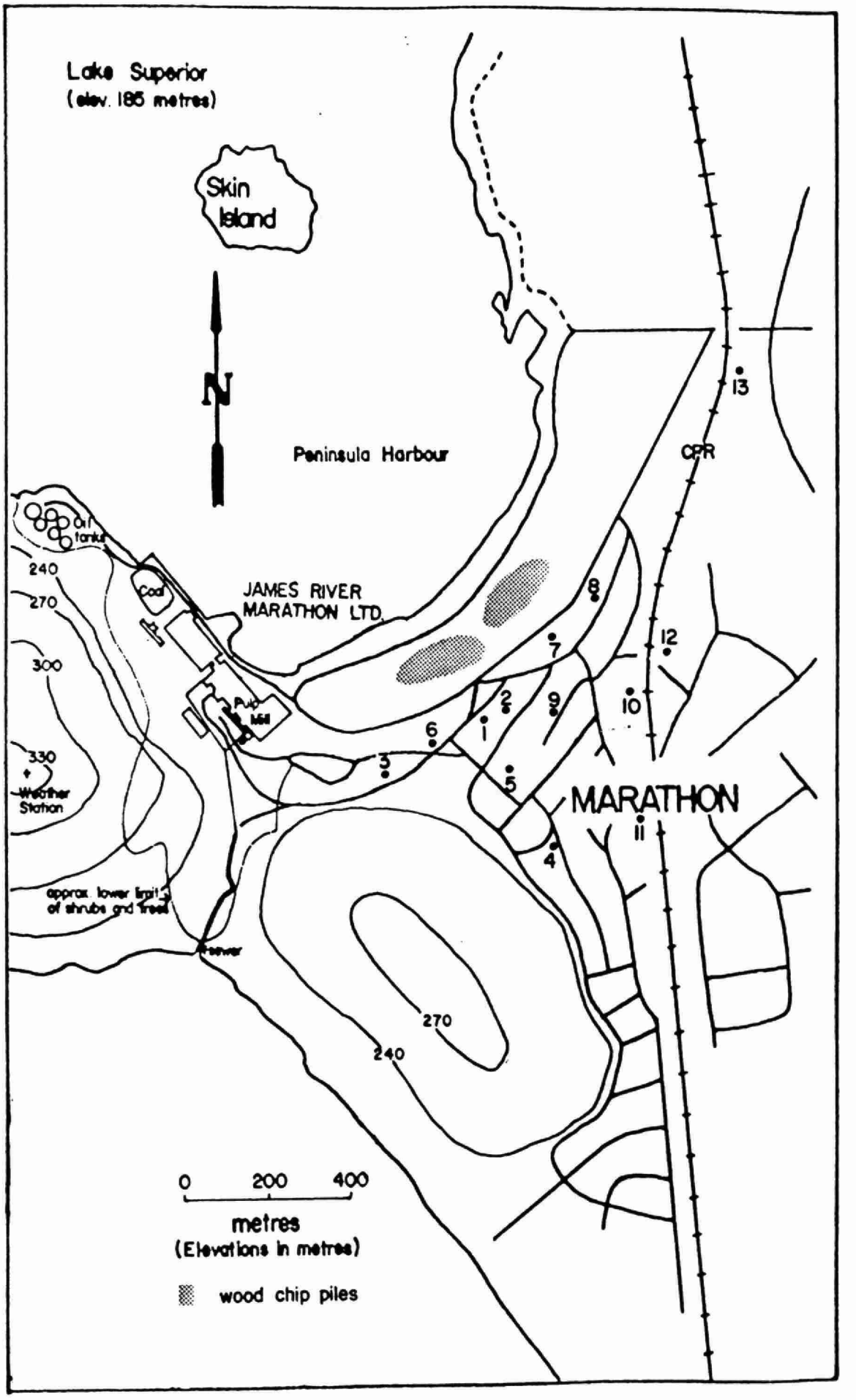

Figure 2. Snow sampling sites, Marathon, January, 1988.

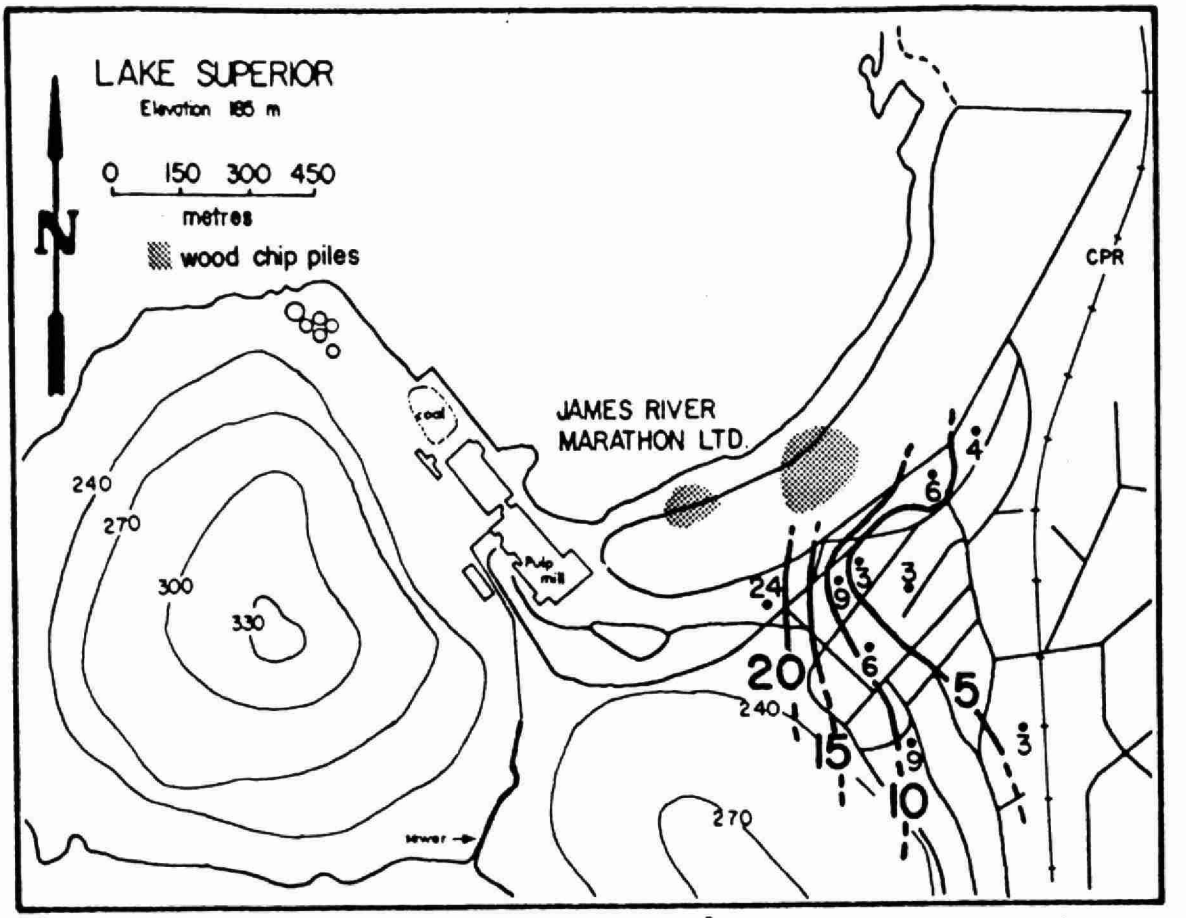

Figure 3a. Deposition rates of total solids ($g/m^2/30$ days) in snow near James River-Marathon, Ltd., Marathon, 1986.

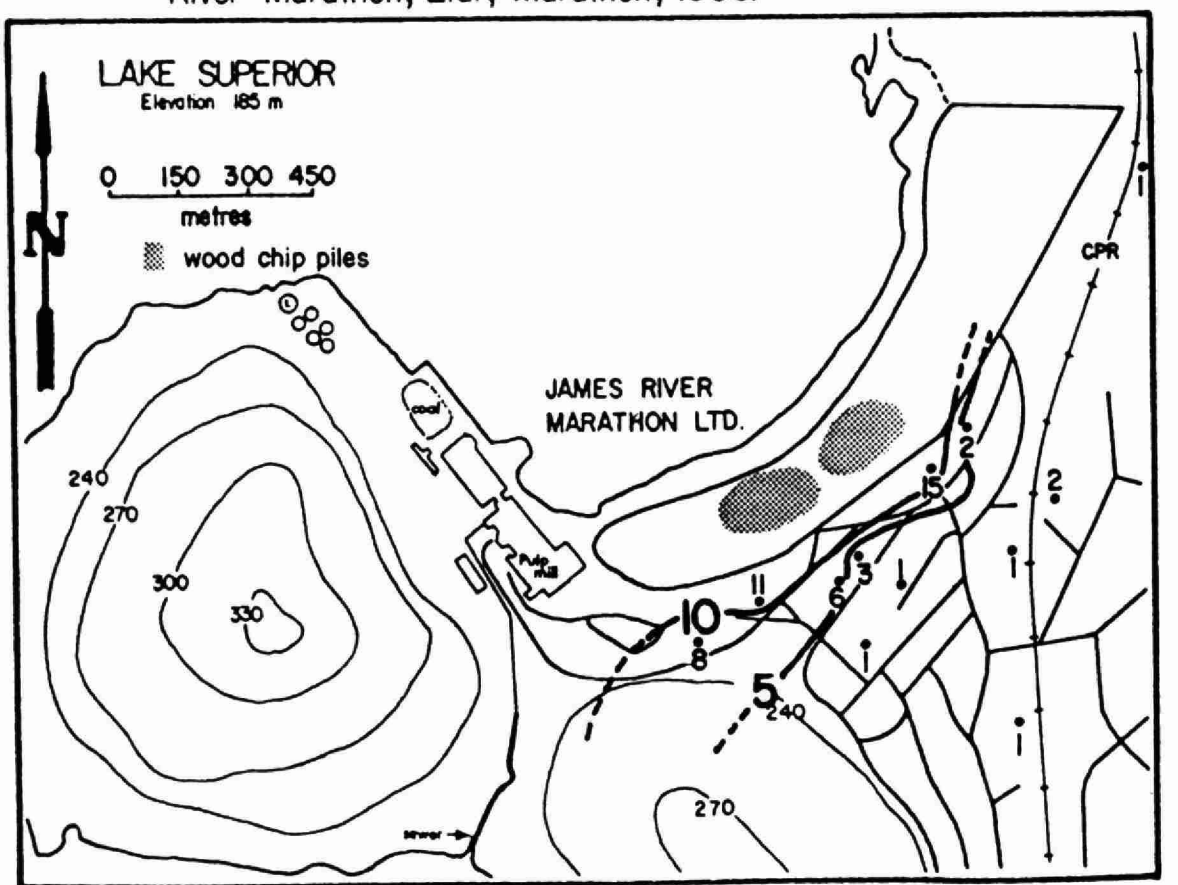

Figure 3b. Deposition rates of total solids ($g/m^2/30$ days) in snow near James River-Marathon, Ltd., Marathon, 1988.

TABLE 1. Total, insoluble and combustible dustfall in the vicinity of James River-Marathon Ltd., Marathon, September, 1987 to August, 1988.

Site[a]	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Mean
	Total dustfall (g/m^2/30 days)												
1[b]	17.9[c]	25.2	12.4	9.7	9.0	9.6	8.6	15.5	16.7	27.4	14.9	22.4	15.8
2	4.9	4.8	4.0	5.2	3.5	2.3	2.5	9.4	3.5	7.6	5.4	6.4	5.0
3	4.1	14.5	4.5	4.9	2.7	2.5	3.9	5.0	5.5	9.3	12.2	26.5	8.0
4	2.9	3.9	0.4	2.0	3.8	-[d]	2.3	4.7	3.1	5.4	2.9	5.0	3.3
	Insoluble dustfall (g/m^2/30 days)												
1[b]	6.6	12.8	5.9	2.9	4.9	4.8	3.8	5.7	4.8	6.7	3.3	4.5	5.6
2	3.8	2.7	2.9	3.0	1.6	2.1	1.9	5.6	2.3	5.2	3.3	3.6	3.2
3	2.8	8.1	2.9	2.7	1.3	2.4	3.0	3.9	4.0	6.0	8.6	20.7	5.5
4	2.4	1.5	0.3	1.0	2.0	-	1.4	3.2	1.6	3.1	1.6	3.1	1.9
	Combustible dustfall (% of total dustfall)												
1[b]	14	12	31	21	30	57	36	21	10	14	17	15	23
2	45	27	32	38	27	70	48	27	3	29	28	26	33
3	20	34	33	39	26	76	51	20	27	31	43	40	37
4	7	23	0	25	26	-	35	15	0	17	3	26	16

[a] See Figure 1.
[b] Site on company property.
[c] Values exceeding air quality objectives (7.0 g/m^2/30 days monthly or 4.6 g/m^2/30 days annual average) are underlined.
[d] Indicates a missing value.

TABLE 2. Levels of calcium, chloride, sodium, sulphate, carbon, solids, conductivity and pH in snow in the vicinity of James River-Marathon, Ltd., Marathon, 1986 and 1988. All values are in mg/l except conductivity (μmhos) and pH.

	Calcium		Cloride		Sodium		Sulphate		Total particulate carbon		Total solids		Conductivity		pH	
Site	1986	1988	1986	1988	1986	1988	1986	1988	1986	1988	1986	1988	1986	1988	1986	1988
1	2	2	3	2	4	5	7	9	80	-[c]	190	130	38	37	6.2	6.1
2	1	1	3	2	3	7	4	13	47	40	130	82	28	48	5.9	5.6
3[a]		1		2		4		6		120		200		31		5.1
4	3[b]	2	6	31	6	24	8	15	64	24	160	140	49	140	7.0	5.8
5	2	<1	2	1	3	2	7	4	71	18	150	51	34	22	6.0	4.9
6[a]	3	2	5	1	4	7	5	14	230	140	540	270	42	54	5.7	5.1
7	1	4	3	8	3	8	4	7	38	58	110	220	27	60	5.9	6.8
8	<1	2	2	10	2	8	2	4	24	17	71	90	18	54	6.0	6.0
9	1	1	2	4	3	4	4	5	35	32	82	83	23	33	5.5	5.9
10	<1	<1	2	1	3	1	3	2	16	-	49	39	21	13	5.0	5.2
11		1		1		4		7		22		53		31		4.9
12		1		2		2		4		30		59		24		5.2
13		1		3		3		4		25		29		31		5.2
Controls	<1	<1	<1	<1	<1	<1	1	1	8	6	24	48	10	16	5.0	4.8
Guidelines	2		4		2		3		7		40		45		-	

[a] Sites on company property.
[b] Note: Values exceeding contaminant guidelines are underlined.
[c] Data unavailable.

TABLE 3. Deposition rates of carbons and solids ($g/m^2/30$ days) in snow collected in the vicinity of James River-Marathon, Ltd., Marathon, January, 1988.

Site	Total particulate carbon		Total solids	
	1986	1988	1986	1988
1	3.8	–[c]	8.9[a]	5.5
2	1.0	1.3	2.8	2.6
3[b]		4.8		7.8
4	3.7	1.9	9.1	11.8
5	2.8	0.4	5.7	1.2
6[b]	10.2	5.8	24.2	11.0
7	2.1	3.9	6.4	14.9
8	1.2	0.3	3.5	1.8
9	2.2	0.5	5.6	1.3
10	0.9	–	2.9	0.9
11		0.4		1.1
12		1.0		1.9
13		0.7		0.8
Controls	0.2	0.4	0.9	0.2

[a] Note: Values exceeding 7.0 $g/m^2/30$ days (Ministry dustfall objective) are underlined.
[b] Sites on company property.
[c] Data unavailable.

TABLE 4. Correlation matrix of selected parameters in snow meltwater, Marathon, January, 1988.

	Ca	Cl	Na	SO_4	Total solids	Total particulate carbon	pH	Conductivity
Cl	0.36							
Na	0.40	0.96*						
SO_4	0.27	0.46	0.68*					
Total solids	0.61*	0.19	0.34	0.54				
Total particulate carbon	0.13	-0.25	-0.09	0.34	0.84*			
pH	0.88*	0.39	0.38	0.12	0.33	-0.15		
Conductivity	0.45	0.95*	0.99*	0.70*	0.39	-0.06	0.40	
Dist.[1]	-0.48	0.18	0.08	-0.14	-0.56*	-0.46	-0.46	0.06
Dist.[2]	-0.18	0.08	-0.08	-0.40	-0.69*	-0.69*	-0.10	-0.09
Dist.[3]	-0.15	0.04	-0.12	-0.43	-0.66*	-0.65*	-0.08	-0.12

*Denotes a significant Pearson correlation for pairs of parameters at the 95% confidence level.

Dist.[1] - distance from sampling sites to edge of wood chip piles

Dist.[2] - distance from sampling sites to recovery boiler

Dist.[3] - distance from sampling sites to lime kiln

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